DOCUMENT RESUME

ED 205 213 IR 009 518

AUTHOR	Lipinski, Hubert: Plummer, Robert P.
TITLE	Graphic Communication in a Group Setting.
INSTITUTION	Institute for the Future, Menlo Park, Calif.
SPONS AGENCY	National Science Foundation, Washington, D.C.
REPORT NO	NSF-P-84
PUB DATE	15 Jun 80
GRANT	MCS-77-01424
NOTE	10p.: Paper presented at the Annual Meeting of the American Society for Information Science (Anaheim, CA, October 5-10, 1980).
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	*Communication (Thought Transfer): *Computer Graphics: *Group Dynamics: Planning: *Problem Solving

ABSTRACT

This paper presents a framework for understanding the various roles and structures for computer graphics in group communication, and discusses three basic types of design decisions that need to be addressed in using such graphics systems: (1) How are the systems to be intergrated in the group communication activity? (2) How are the systems to be structured to promote exchange of graphical images? and (3) What level of primitives is needed to facilitate this exchange? A discussion of the evaluation of graphic communication includes examples of the types of task-related questions that can be used to determine the most appropriate graphic communication structure for a particular group problem solving task. Ten references are cited. (Author/LLS)

GRAPHIC COMMUNICATION IN A GROUP SETTING

by

Hubert Lipinski and Robert P. Plummer

prepared for

ASIS-80
Anaheim, California
October 5-10, 1980

This material is based upon work supported by the National Science Foundation under Grant MCS 77-01424

Institute for the Future
2740 Sand Hill Road
Menlo Park, California 94025

June 15, 1980

Paper P-84

GRAPHIC COMMUNICATION IN A GROUP SETTING

Hubert Lipinski and Robert P. Plummer
Institute for the Future
Menlo Park, California

Abstract. This paper presents a framework for understanding the various roles and structures for computer graphics in group communication. We discuss three basic types of design decisions that need to be addressed in using such graphics systems: How are they to be integrated in the group communication activity? How are they to be structured to promote exchange of graphical images? And what level of primitives is needed to facilitate this exchange? Finally, we postulate some questions whose answers can help evaluate what type of graphic communication system would be most appropriate for the group activity.

INTRODUCTION

Over the past two and a half years, the Institute for the Future has been developing a computer-based group communication system to support modeling activities. (1) In designing this system, we recognized the need for graphic as well as verbal (text-based) communication in modeling applications. The literature on modeling and on group communication supports this view. (2)

Those who work as facilitators of group communication have also stressed the value of graphic communication for group problem solving, not only for displaying information, but also for developing concepts. For example, Geoffrey Ball, who works as a conflict resolution consultant, claims that: "Graphic displays enable task-oriented groups to work together more effectively (as measured by product quality and member satisfaction) than does verbal communication alone." (3) Commenting on group dynamics and "visual thinking," Joseph Brunon says:

> Many individuals need to draw while they talk in order to express their ideas. . . . To talk as one draws means to

> reason as one perceives; to define as one designs; and to intellectualize as one intuits. . . . A basic approach to group dynamics in problem-solving situations needs to recognize the unity of perception and thought. Rather than concentrate only on the intellectual, defining processes, in which thought products have been finalized prior to discussion, and the response pattern of one member has no way to interact with the response pattern of another, we want to bring into play the intuitive, perceptual processes of each member, and have the group develop thought products together. (4)

All of these perspectives suggest that text-based communication alone is inadequate for many problem-solving situations--that an effective group communication medium should support graphic communication as well.

COMPUTER GRAPHICS

A substantial amount of work has been done on the theory and techniques for computer generation of graphic images. Most relevant is the development of a number of graphics systems or "packages" designed to simplify the picture-generation process for the user. (5) A "typical" system has the following characteristics:

- It consists of a set of subroutines that can be called from a high-level host language, usually FORTRAN.
- Applications programs use the computational capabilities and control structures of the host language.
- The graphics subroutines allow objects to be constructed out of points, lines, and curves called "primitives"; they perform object transformations such as rotation, translation, and scaling; they allow text to be displayed as part of the picture; and they provide some capability for graphing numerical data.

- The system can be run on several different host computers.

- The system exhibits some degree of device-independence; that is, it can produce pictures on more than one kind of output device (for example, a CRT, plotter, or printer).

While all of these characteristics can be desirable in graphic communication, for many users, it is inappropriate to require the use of a programming language in order to produce graphics. An alternative is suggested by work in the area of computer-aided design (CAD). (6)

CAD systems are normally interactive. The user constructs a picture out of basic "building blocks" that might appear around the perimeter of a CRT display. A device such as a light pen, joystick, or tablet is used to select items and position them in the picture. When the picture is complete, it may be given a name and saved for later display, modification, or inclusion as part of another picture. CAD systems for tasks such as circuit design have the capability not only to produce a picture of a circuit, but also to simulate its operation.

Although CAD systems provide sophisticated graphics capabilities, almost all are single-user systems; thus, they do not address the questions that arise when a group of users shares a visual space in order to create, modify, view, and discuss graphic images. In addition, many CAD systems operate on expensive, specialized terminals that are not accessible to the general user.

DESIGNS FOR GROUP GRAPHIC COMMUNICATION

Three basic decisions must be made in implementing a graphic communication system designed for group use:

- How is the graphics system to be integrated into the task requirements of the group?

- How is the graphic communication component structured to achieve the group's desired goals?

- What level of primitives is appropriate to the task at hand?

Graphic communication is not an end in itself, but rather one of the modes of communication used by a group involved in a particular problem-solving activity. As such, it is one component of a larger communication structure that emphasizes the task-oriented focus of the group activity. Graphic communication may be desired for any number of reasons--for simple graphs or illustrations that will be part of a report, for flowcharts of processes, for plans of a structure or piece of equipment to be built, etc. Clearly, the role graphics are to play will exert a strong influence on the systems designer trying to integrate graphics into a group communication setting.

When graphics have been integrated into the communications activity of the group, one must still understand how the components actually will be used. The primary alternatives are synchronous use, asynchronous use, or a mixture of both--with or without a parallel channel for text (or voice) communication. The graphics may also be presented and stored in a number of formats. Basic design decisions involve when to store previous versions, how to differentiate various pictures, and what to store--all quite dependent on the particular task of the group.

Even though the graphics package will produce the same image for a wide spectrum of low to high primitive definitions, all levels of definition may not be of equal use to the group involved in the graphic communication process. The group generally needs to discuss the graphic image and therefore needs convenient handles to develop and sustain their ideas. Thus, low-level primitives such as defined by the CORE system might prove cumbersome if they formed the basis of a problem-focused discussion.

A number of existing graphic communication systems can be analyzed in relation to these three basic levels of design decisions. One example is the picture language used by the Electronic Information Exchange System (EIES) at the New Jersey Institute of Technology. (7) Here the graphics are embedded in text and thus are integrated into the electronic message exchange and document preparation capabilities of the EIES system. Because of the time needed to create images, the graphics seem more suited to asynchronous use. The primitives are fairly low-level but are expandable upward and can be used from hard-copy terminals. Another recent example of graphics embedded in text but more focused to document preparation is a system at Lawrence Livermore Laboratory. (8)

Graphics systems that feature a shared visual space are adapted more toward synchronous use. Such systems generally have a common or subdivided visual space and use advanced graphics terminals for input and output of graphical data. An example is the network-oriented color graphical conferencing system being built at the Rand Corporation. (9) This type of approach is somewhat less integrated than graphics embedded in text, with the result that the graphics mode of communication is emphasized over the task activity.

Another approach is a hybrid graphics system combining the integration/asynchronous outputs of graphics embedded in text with the synchronous capabilities of the shared visual space. This has been the approach followed in the graphic communication subcomponent of the HUB system developed at the Institute for the Future.

The design of the shared visual space component in the HUB system allows users to create or modify graphic images jointly. During this process, they may exchange text-based messages, and at the conclusion of the process, the picture and accompanying comments are shared as a single entry in a computer-based conferencing transcript. Thus, the HUB system attempts to make a smooth transition between synchronous/asynchronous use of graphic communication as well as integrating that communication with other types of communication.

HUB allows one not only to create new pictures but also to modify existing pictures that have been stored in the activity. Since at the end of each picture-modifying session one is given the option of storing the resulting picture primitives (as well as the comments generated during the picture development process), these picture primitives can then be used as input in a future session with either the last or indicated version being modified.

The shared visual space capability in the HUB system is designed to be independent of the package supporting the graphics, thus allowing an optimal choice of primitives. The only requirements imposed on the package are that the graphic image be stored as a set of picture primitives so that inputting a picture to and saving a final graphical product can be accomplished through a file of such primitives.

EVALUATING GRAPHIC COMMUNICATION

Since there is no optimal structure for graphic communication, appropriate structures must be matched to various tasks. For example, a problem-solving process basically involves two types of graphics: graphics to help conceptualize in the problem formulation phase and graphics to aid in the analysis of results. (10) Similarly, the appropriateness of a graphic communication structure is dependent on the specific task for which it is used.

In our earlier work in computer conferencing, we developed a taxonomy of group communication with four major categories: medium, group characteristics, individual personalities, and tasks. Starting from this taxonomy, one can systematically ask about the effects of graphics systems on group communication. The following task-related questions are particularly interesting: For what tasks will the system be most commonly used? What is the effect of the graphic capability on the tasks? What portions of a task rely heavily on the graphic capability, and what portions seem to require text, voice, video, etc.? How does the graphic capability change the nature of any given task? Regarding the group dynamics, who assumes leadership in this kind of communication? What are leadership tasks? What are other typical roles? Are there some users who always make changes in the picture itself while others reserve their comments for text messages only? How do users negotiate changes in a picture, and how to they decide when it is complete? What are users' perceptions about ownership of pictures? Is there sufficient congruence in the conception of a graphic image to allow a group to work with a single, shared picture?

Answers to these types of questions can help define the role, structure, and primitives requirements of graphic communication.

CONCLUSION

We have tried to present a framework for understanding and evaluating the various roles and structures for graphic communication. By placing graphic communication in a larger setting, one may focus on the suitability of various communication structures and the choice of the optimal level of primitives for a particular problem-solving task.

ACKNOWLEDGMENTS

This material is based upon work supported by the National Science Foundation under Grant MCS 77-01424. We wish to acknowledge Kathleen Spangler Vian for her contributions to both the content and structure of this paper.

REFERENCES

(1) LIPINSKI, HUBERT et al. "Interactive Group Modeling, Part 1: Extending Group Communication Through Computers"; "Part 2: An Interactive Monitor"; "Part 3: HUB and the Modeling Process"; and "Part 4: Some Preliminary Tests of the HUB System." Institute for the Future, August 1979.

(2) MAR, BRIAN W. "Assessment of RANN Regional Environmental Systems Projects." Workshop Reports, Volume 1; report to the National Science Foundation, Research Applied to National Needs, 1977, p. 24, and KUH, EDWIN. "Conference on Model Formulation, Validation, and Improvement." Report to the National Science Foundation, Vail, Colorado, June 14-15, 1975, p. 17.

(3) BALL, GEOFFREY. "Using Graphics with Groups," Cooperative Planning Network, Santa Clara County, California, June 1978, p. 4.

(4) BRUNON, JOSEPH. "Group Dynamics and Visual Thinking." Journal of Architectural Education, Vol. 26, No. 3, 1979, p. 53.

(5) EWALD, R.H.; FRYER, R.; eds. "Final Report of the GSPC Subcommittee." Computer Graphics, Vol. 12, No. 1, 1978, pp. 14-169. (This report surveys eight graphics systems.) See also BERGERON, R.D.; BONO, P.R.; FOLEY, J.D. "Graphics Programming Using the Core System." Computer Surveys, Vol. 10, No. 4, December 1978, pp. 389-443.

(6) ELLIOTT, W.S. "Interactive Graphical CAD in Mechanical Engineering Design." Computer Graphics, Vol. 10, No. 2, March 1978, pp. 91-100.

(7) BAER, A.; TUROFF, M. "Text Enhancement and Structuring in Computer Conferencing." (Presented at the Conference on Processing of Visible Language 2, University of Toronto, Toronto, Canada, September 3-6, 1979.)

(8) BEATTY, JOHN C.; CHIN, JANET S.; MOLL, HENRY F. "An Interactive Documentation System." Computer Graphics, Vol. 13, No. 2, August 1979.

(9) O'BRIEN, MICHAEL T. "A Network Graphical Conferencing System." Computer Graphics, Vol. 13, No. 2., August 1979.

(10) See for example: CAHN, DEBORAH U.; JOHNSTON, NANCY E.; JOHNSTON, WILLIAM E. "A Response to the 1977 GSPC Core Graphics System." Computer Graphics, Vol. 13, No. 2, August 1979.